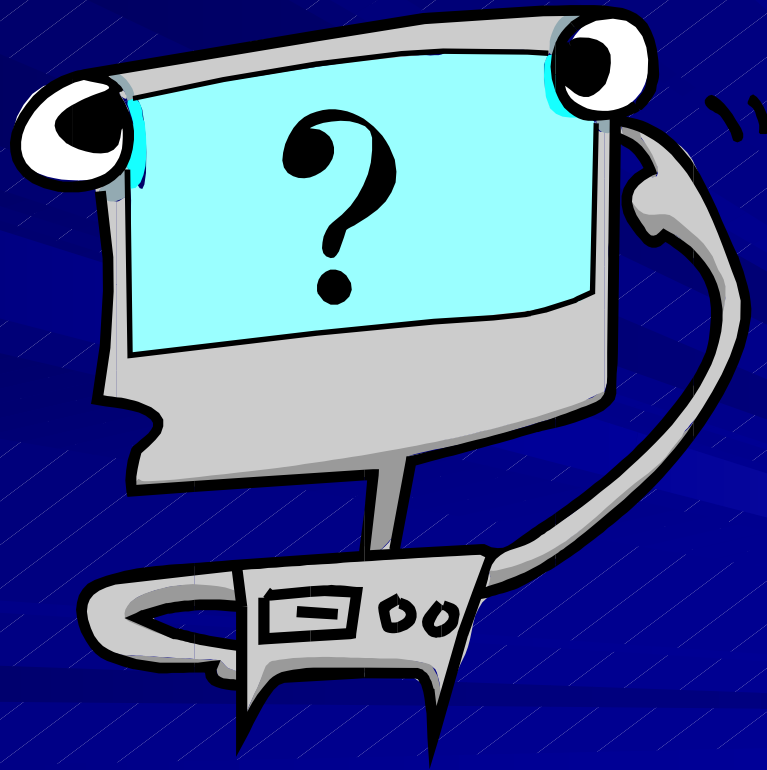


Programs and Protocols: Temperature Monitoring



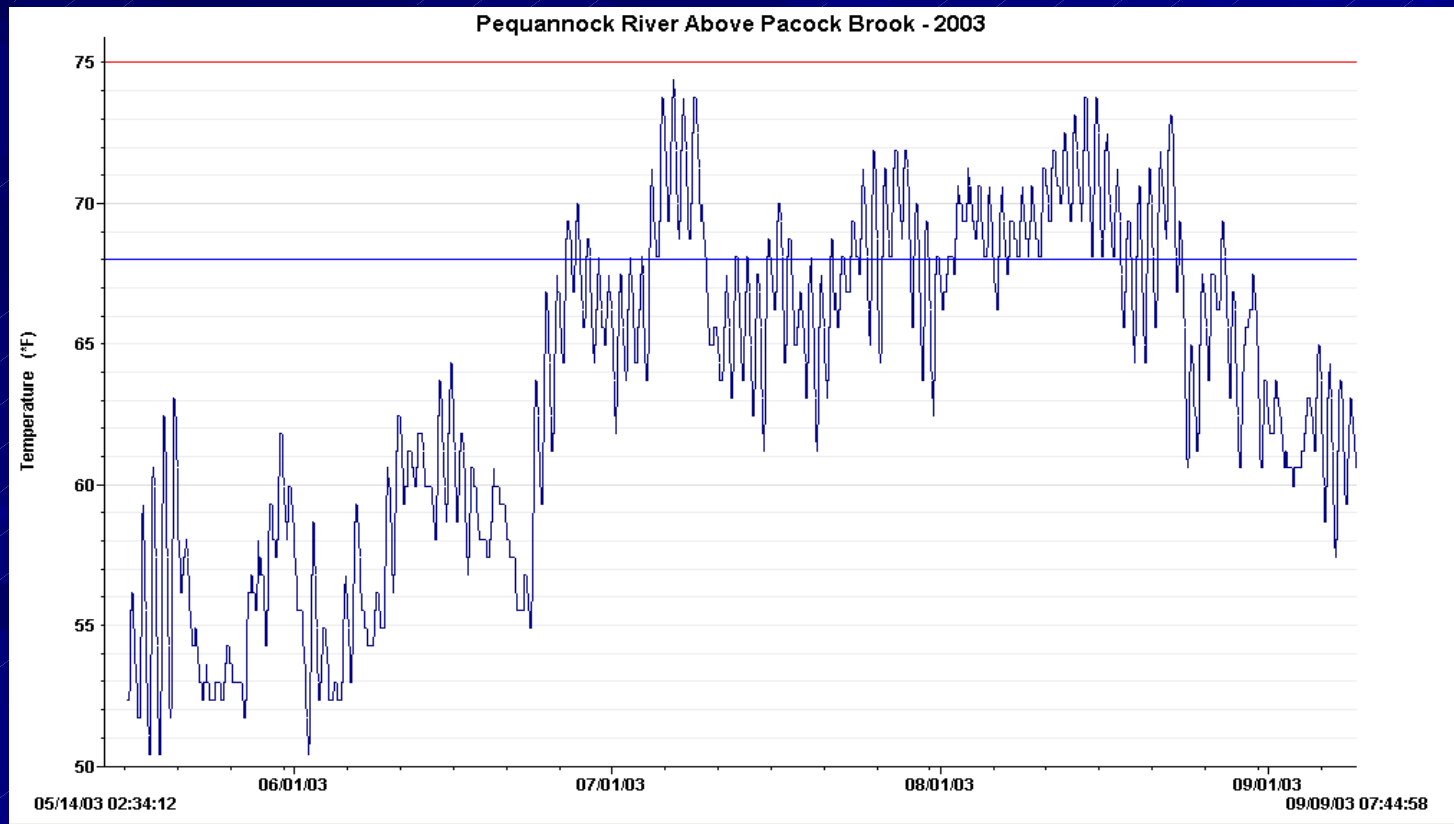
a presentation of the
Pequannock River Coalition

Why choose temperature monitoring?



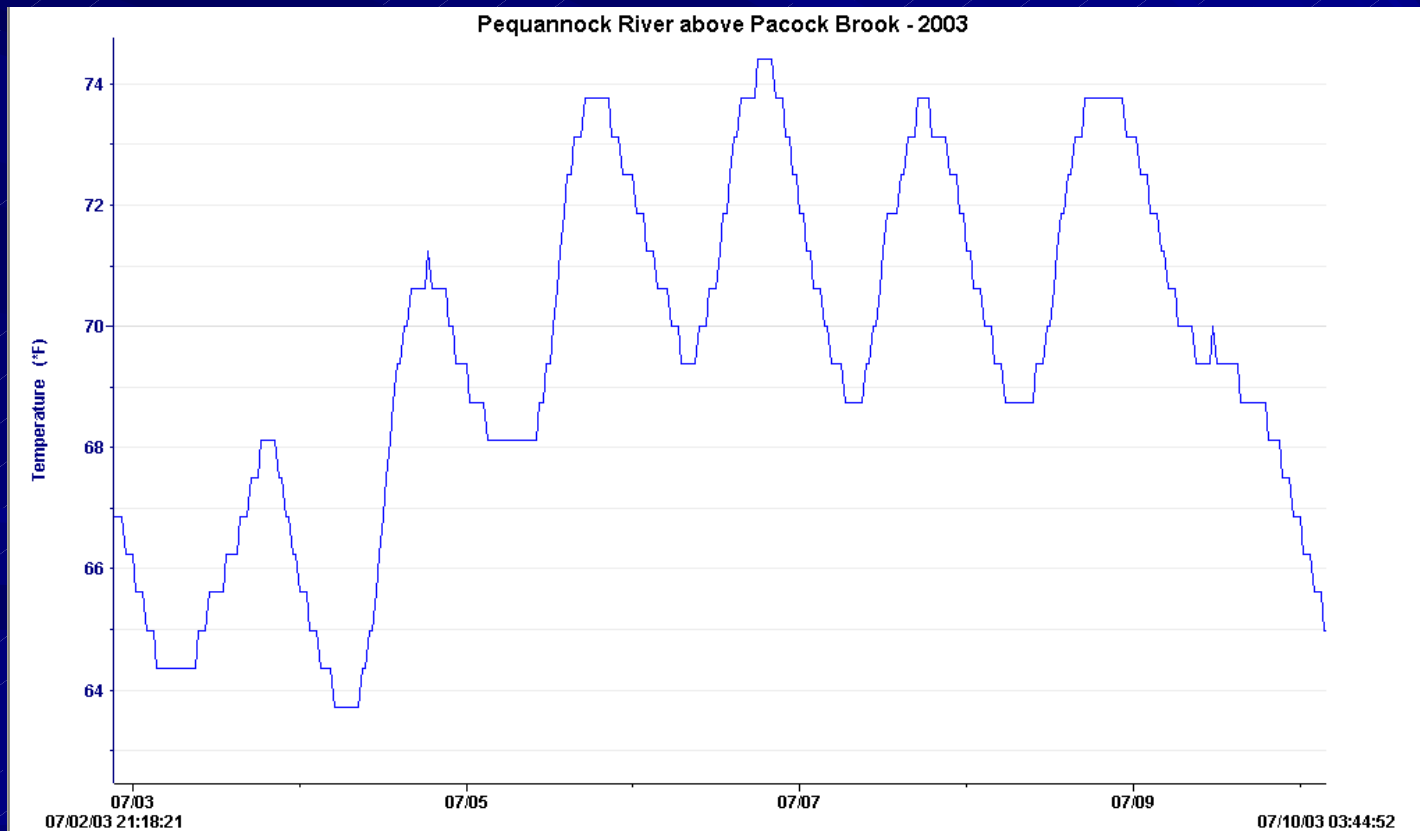
Constant Sampling

Data is captured over long periods. Like macroinvertebrate sampling, this can identify problems occurring at isolated intervals.



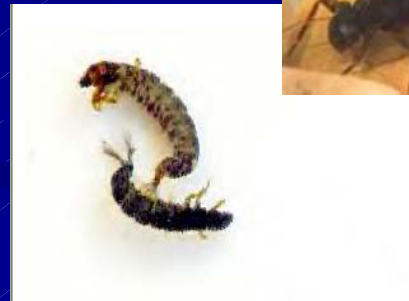
Constant Sampling

- Water temperature is extremely dynamic, changing month to month, day to day and hour to hour. Constant sampling is necessary to provide meaningful results.



Identifies problems other methods cannot

- Chemical monitoring provides only a one-time “snapshot.”
- Macroinvertebrate sampling is not always as sensitive. Sampling of the Pequannock River before and after a major fish kill in 1994 showed no substantial change in macroinvertebrate populations.



Fills a gap in State sampling

- Current State temperature sampling relies on few readings over an entire summer. Due to the dynamic nature of water temperature this is unlikely to identify problems.

SAMPLE DATETIME	MEDIUM CODE	Temper- ature, water, deg C (00010)	Baro- metric pres- sure, mm Hg (00025)	Agency col- lecting sample, code (00027)	Agency anal- yzing sample, code (00028)	Instan- taneous dis- charge, cfs (00061)	Stream stage, feet (00065)	Specif. conduc- tance, wat unf uS/cm 25 degC (00095)	Dis- solved oxygen, mg/L (00300)	BOD, water, unfltrd 5 day, 20 degC mg/L (00310)
1999-02-02 11:00	9	1.0	747	34001	80020	14	2.56	213	15.0	2.2
1999-05-04 11:00	9	11.5	733	34001	80020	10	2.46	182	10.1	≤ 1.0
1999-08-18 10:30	9	23.0	746	34001	80020	.92	1.96	224	6.9	E 1.0
1999-11-16 10:15	9	4.0	737	34001	80020	4.4	2.28	224	11.0	E 1.5
Water Quality Remark Code	Description									
<	Actual value is known to be less than the value shown.									

USGS Data - Ambient Stream Monitoring Network

Cost Effective

Costs for a basic temperature monitoring program are relatively low.

Example:

FIRST YEAR

5 data loggers	\$650
Software	\$175
ANSI thermometer	\$200
<u>Misc. Equipment</u>	<u>\$200</u>
First Year Total	\$1,225

SECOND YEAR

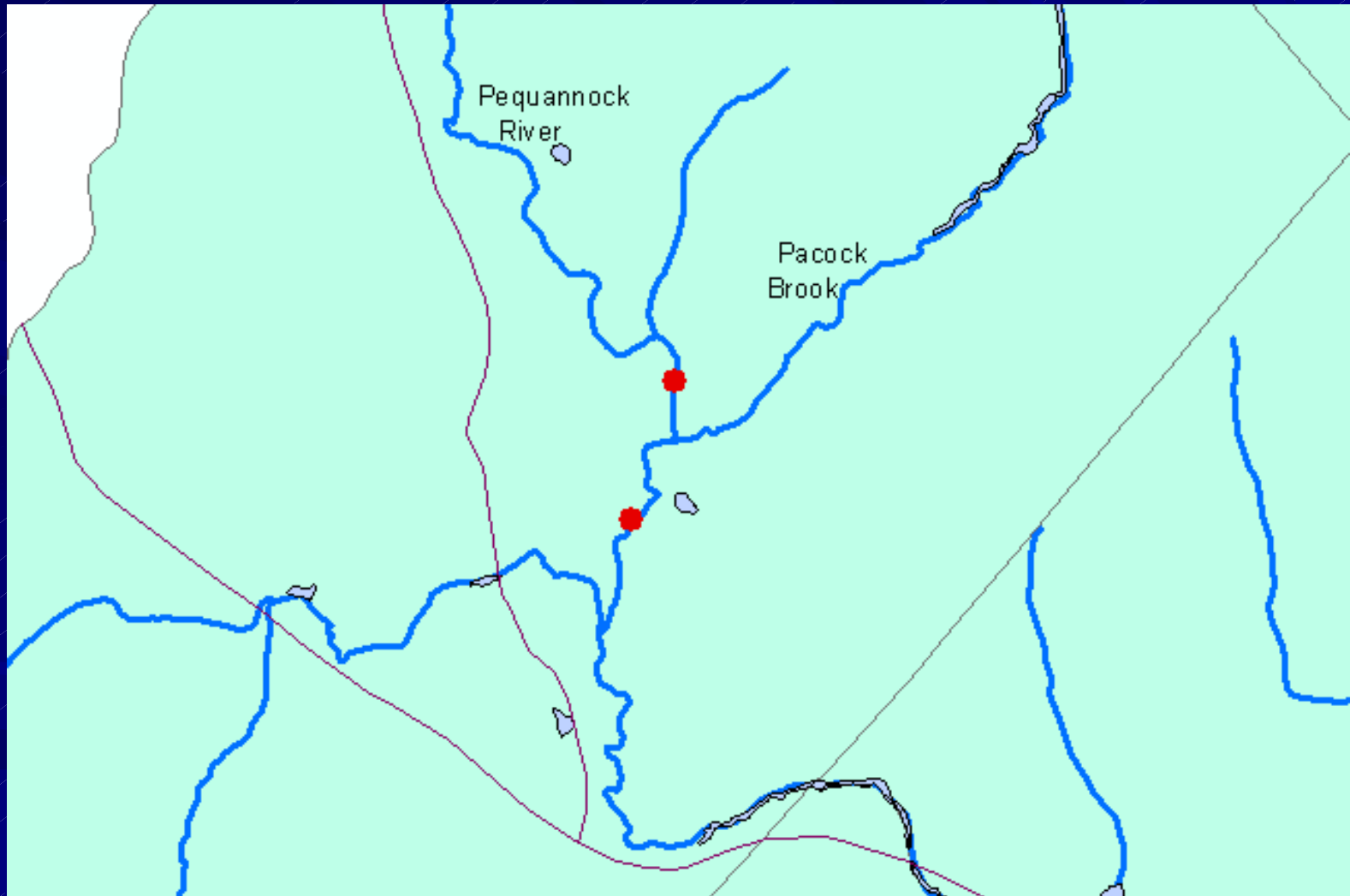
Certify thermometer	\$200
<u>Misc. equipment</u>	<u>\$200</u>
Second Year Total	\$400

Can locate specific problem sources

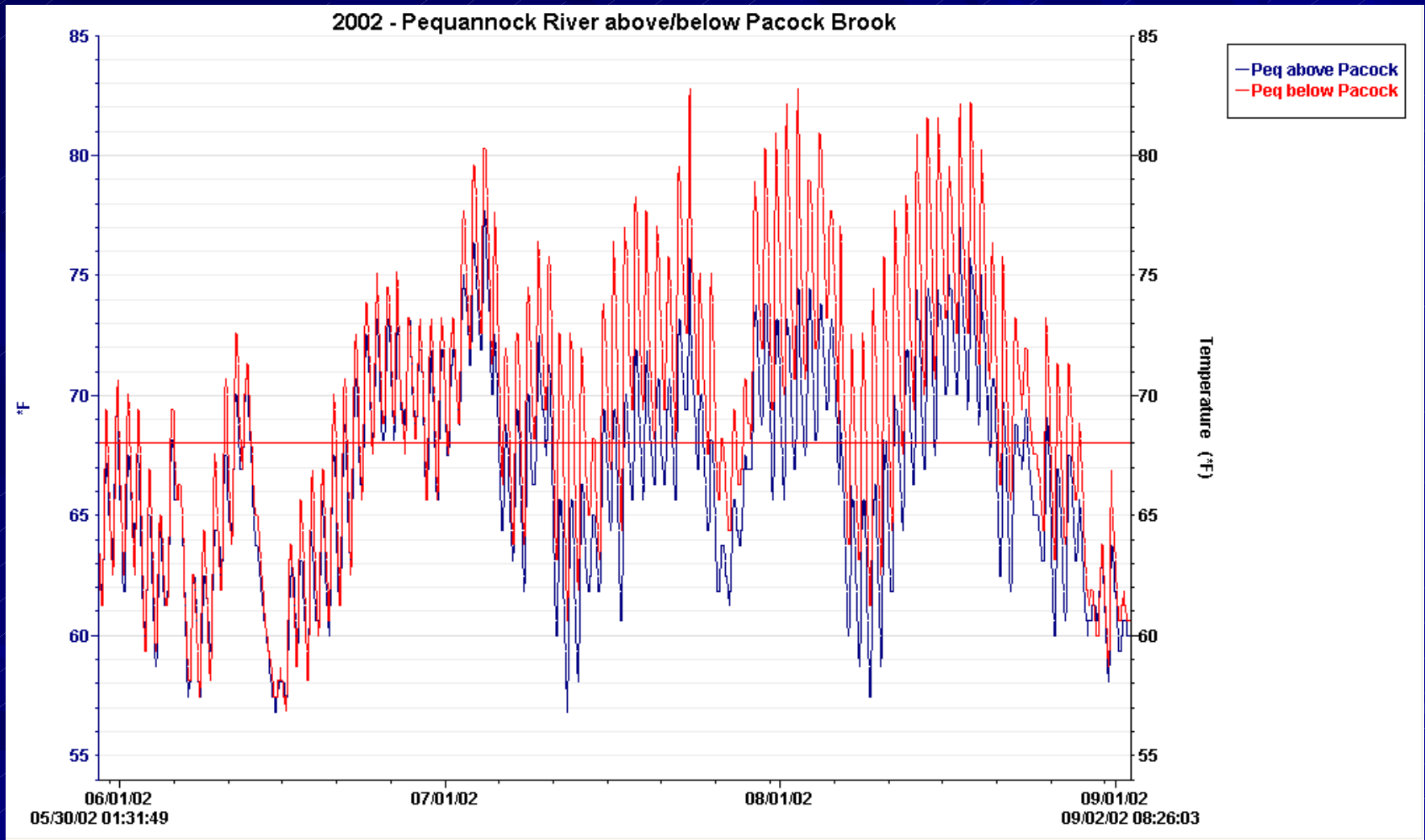
- Monitoring can be finely tuned to identify and measure discrete influences.
- By sampling above and below NJPDES discharges, tributary mouths, stormwater outfalls or impoundments the impacts of these features can be accurately measured.



Example: What influence does Pacock Brook have on the Pequannock River?



Answer? OUCH!!!



Certified Results

Appendix 1A

State of New Jersey's
2002 Integrated List of Waterbodies

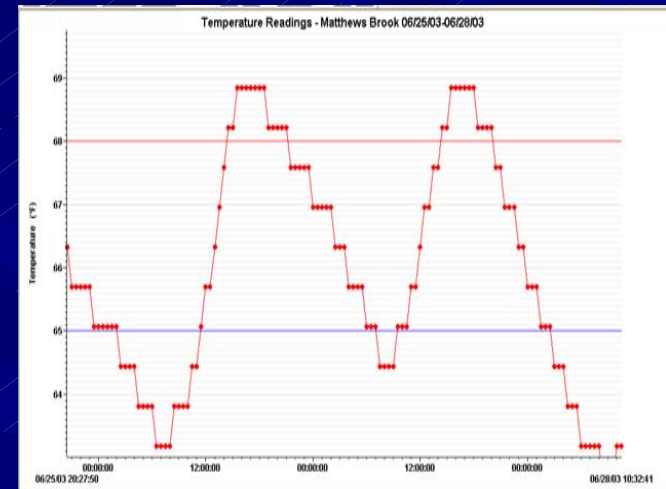
Sublist 5

Region	WMA	Station Name/Waterbody	Site ID #	Parameters (Non Attaining)	Data Source
Northeast	03	Greenwood Lake-03	Greenwood Lake	Nutrients/Sedimentation (Eutrophic), Dissolved Oxygen, Phosphorus	NJDEP Clean Lakes Program
Northeast	03	Kitchell Lake-03	Kitchell Lake Assoc.	Fecal Coliform	Passaic Co HD
Northeast	03	Lake Iosco-03	Lake Iosco	Fecal Coliform	Passaic Co HD
Northeast	03	Lindy Lake-03	Lindy Lake Association	Fecal Coliform	Passaic Co HD
Northeast	03	Lionhead Lake-03	Lions Head Lake	Fecal Coliform	Passaic Co HD
Northeast	03	Macopin River	PQ6	Temperature	Pequannock River Coalition
Northeast	03	Macopin River at Macopin Reservoir	01382450	Fecal Coliform	NJDEP/USGS Data
Northeast	03	Meadow Brook at Highland Ave in Wanaque	AN0256A	Aquatic Life	NJDEP AMNET
Northeast	03	Monksville Reservoir-03	Monksville Reservoir	Fish-Mercury	NJDEP Fish Tissue Monitoring
Northeast	03	Morse Lake-03	Morse Lake POA, Morse Lake	Fecal Coliform	Twp of Pequannock
Northeast	03	Packanack Lake-03	Packanack Lake East and West	Fecal Coliform	Passaic Co HD
Northeast	03	Pequannock River - Butler	PQ10	Temperature	Pequannock River Coalition
Northeast	03	Pequannock River above Clinton	PQ4	Temperature	Pequannock River Coalition
Northeast	03	Pequannock River above Macopin	PQ7	Temperature	Pequannock River Coalition
Northeast	03	Pequannock River at Macopin Intake Dam	01382500, 3-SITE-8, 3-PEQ-1, PQ8	Temperature, Lead	NJDEP/USGS Data, Metal Recon

- NJDEP laboratory certification is achievable for almost any group with **consistent** volunteer or staff effort. Certification assures inclusion of data in federal 303D list.

Great graphics, understandable data

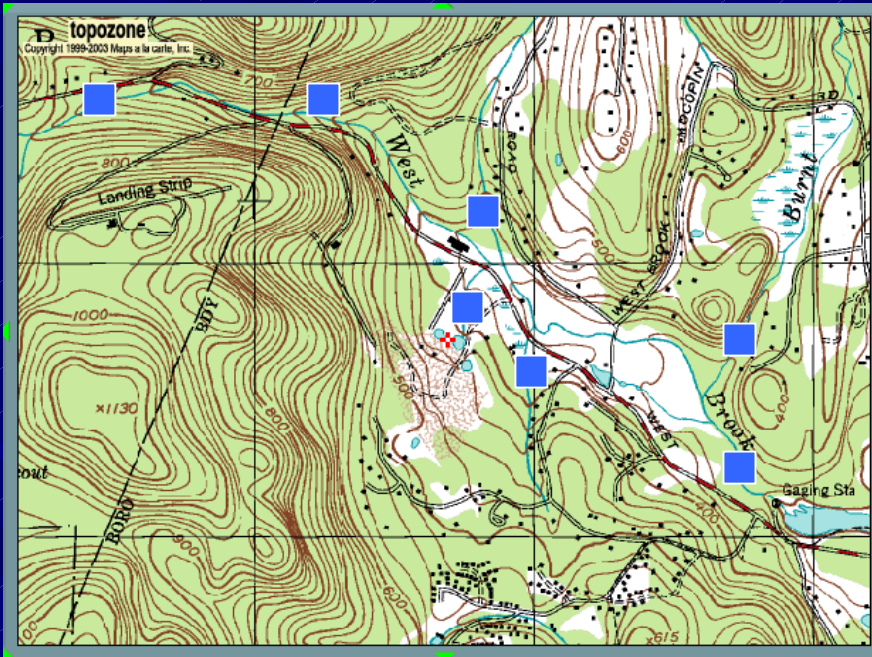
- The visual nature of the data produced lends itself well to public presentations.
- Results are objective and indisputable
- Problems, trends, and relative results are accurately depicted and easy to convey.



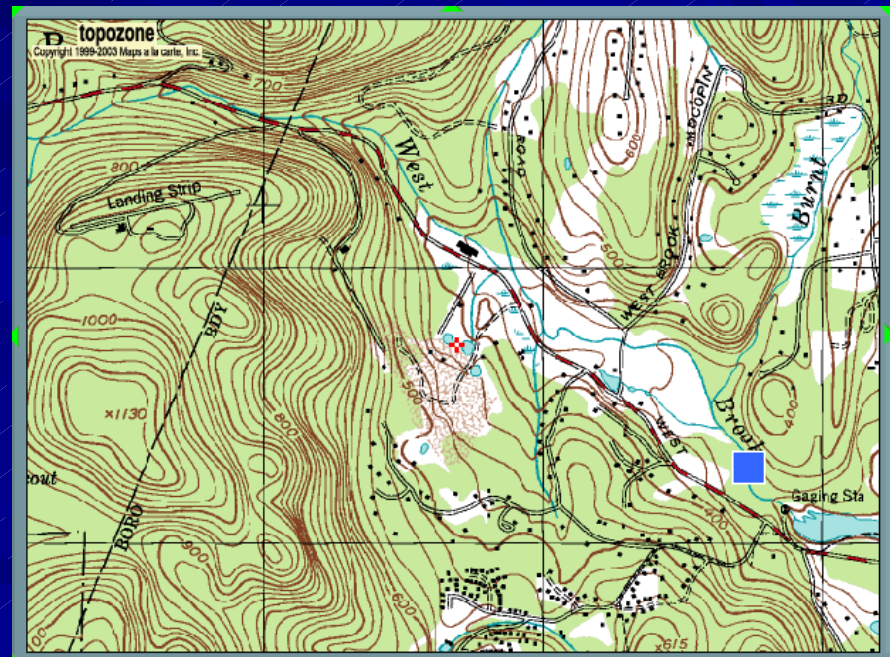
1 - Matthews Brook, West Milford (above Echo Lake)

Scalable

Programs can be as intensive or broad as your budget allows or watershed requires.



Intensive



Broad

Broad Applicability

Temperature monitoring need not be confined to trout-associated waterways!

- The temperature of any waterway, like human body temperature, is an excellent indicator of overall “health.”
- Rivers and streams with intact watersheds consistently produce cooler, cleaner flows.
- Non-trout waters have requirements too! State limits are 82F for smallmouth bass/yellow perch waters and 86F for others.



Drawbacks?

- Temperature monitoring can tell you What, When and Where – but not **WHY!**
- Detailed knowledge of your watershed is essential. Once problems are encountered visual assessment is critical in identifying sources of temperature elevation.
- No “silver bullet.” Does not replace chemical, biological or other monitoring.

Case Study

Guess Who?

PEQUANNOCK RIVER COALITION

- Founded 1994

- Our mission:

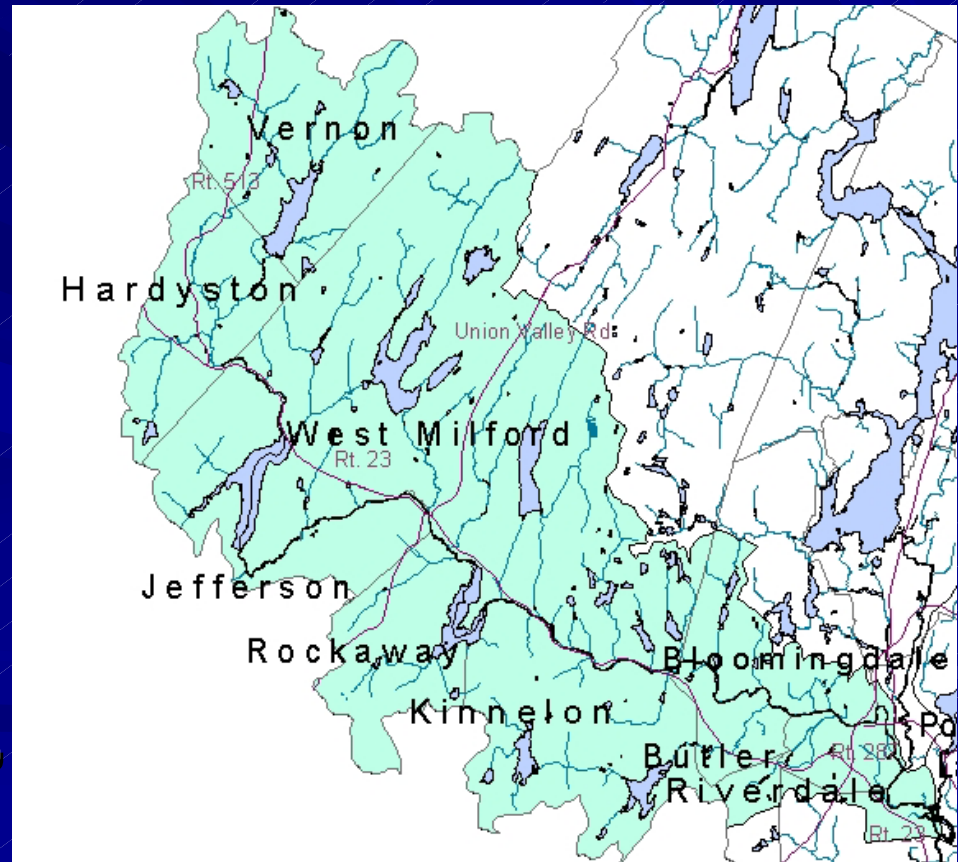
*Preservation of the
Pequannock River
as a natural,
aesthetic,
recreational and
water supply
resource.*

- Membership: *Citizens and groups in 55 towns, 5 states.*



Pequannock Watershed

- **Area:** 98 square miles
- **Municipalities:** 11
(Vernon, Hardyston, Jefferson, West Milford, Rockaway, Kinnelon, Bloomingdale, Butler, Riverdale, Pompton Lakes, Pequannock)
- **Counties:** 3 (Passaic, Morris, Sussex)



Pequannock River Coalition Programs

- Public Outreach and Education
- Advocacy, Regulation and Public Policy
- River Access / Greenway Acquisition
- Water Temperature Monitoring



Why did we choose temperature monitoring?

Trout!

Much of the of the Pequannock River mainstem and many river tributaries are classified as “trout production” where temperature can be a major limiting factor.

First documented fish kill caused by high river temperatures in the West Milford area in 1994 .

River temperature reached 82F.



A second fish kill occurred in the same area in 2002.

River temperature reached 83F.

Pequannock River Trout Facts

- River miles classed as Trout production (Category 1): **20**
- Major trout production tributaries:
**Kanouse Brook,
Clinton Brook,
Apshawa Brook,
Kakeout Brook.**
- Trout species:
Brook trout, Brown trout



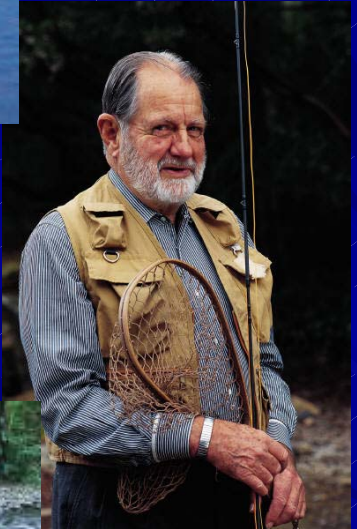
Pequannock River - Federal Hill, Bloomingdale

Why are trout important?



Trout are important as a recreational resource

- As a “designated use” angling is specifically protected under the Clean Water Act.
- Recreational users can be a waterway’s most vocal and effective advocates.



Trout are indicators of high water quality with strict requirements:

Oxygen level: 4 parts per million

pH: 4.5 – 9.5

Temperature – Desired range: 58F- 68F

Lethal limits:

Brown Trout – 78F

Brook Trout – 75F



Trout are a vital link in the Pequannock River food chain.



Northern
Water
Snake



Yellow-crowned
Night Heron



Great
Blue
Heron



River
Otter

Regulatory Protection

As the “established biota” of the Pequannock River, trout are protected under the Federal Clean Water Act and NJ Surface Water Quality Standards.

- Protected from “measurable changes in water quality”
- No manmade wastewater discharges
- No other activities that might cause negative changes to water quality
- **Maximum temperature of 68F**



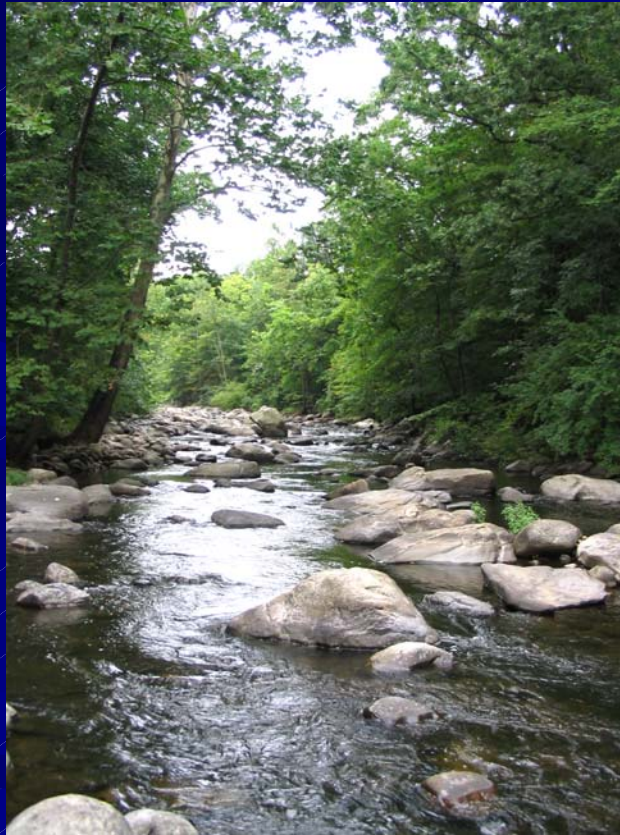
Pequannock River Coalition Temperature Monitoring Program

1996

Program Started

2001

Licensed as
laboratory



2003

Earned EPA
Environmental
Quality Award

&

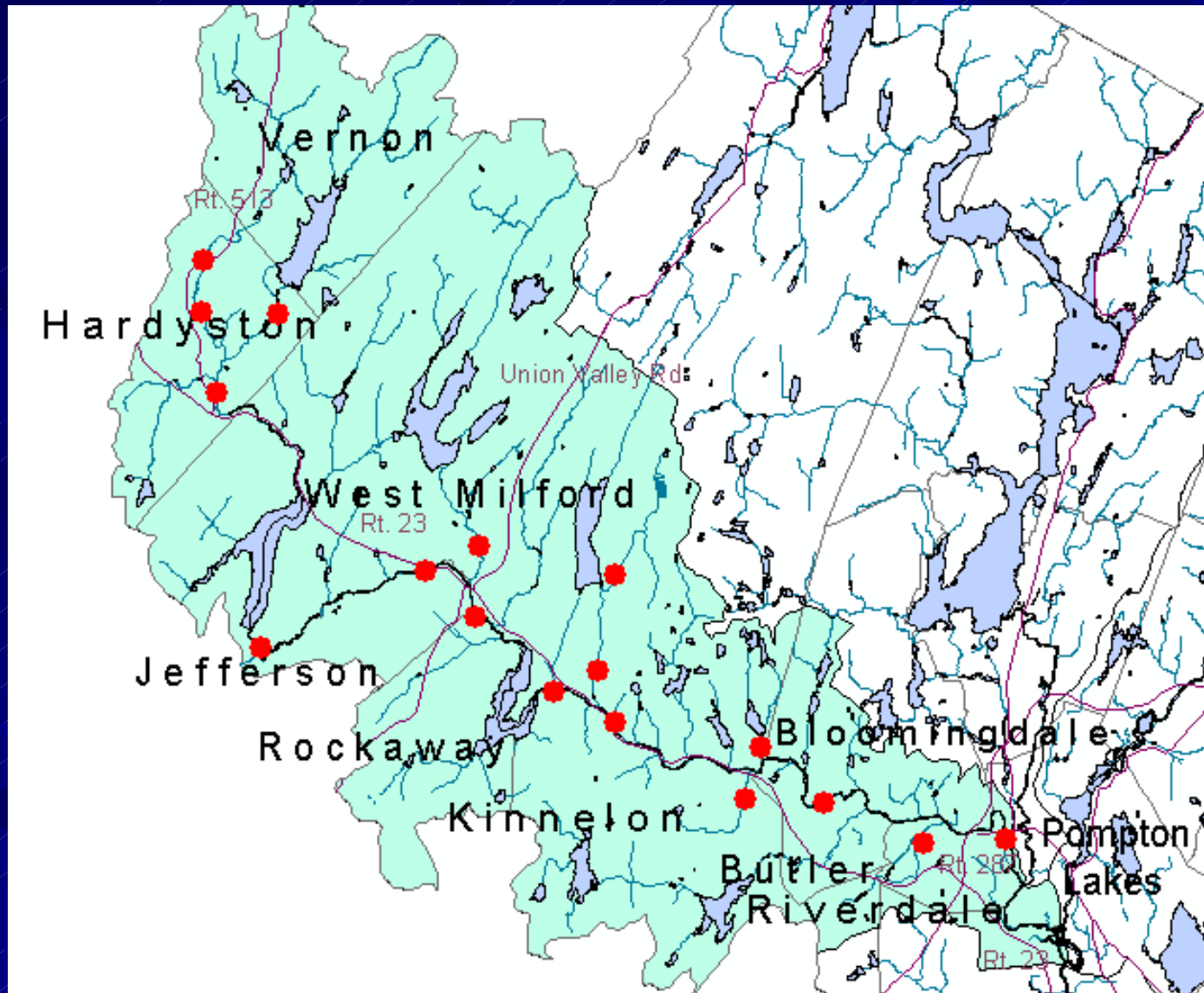
NJDEP
Environmental
Excellence
Award

How does our program work?

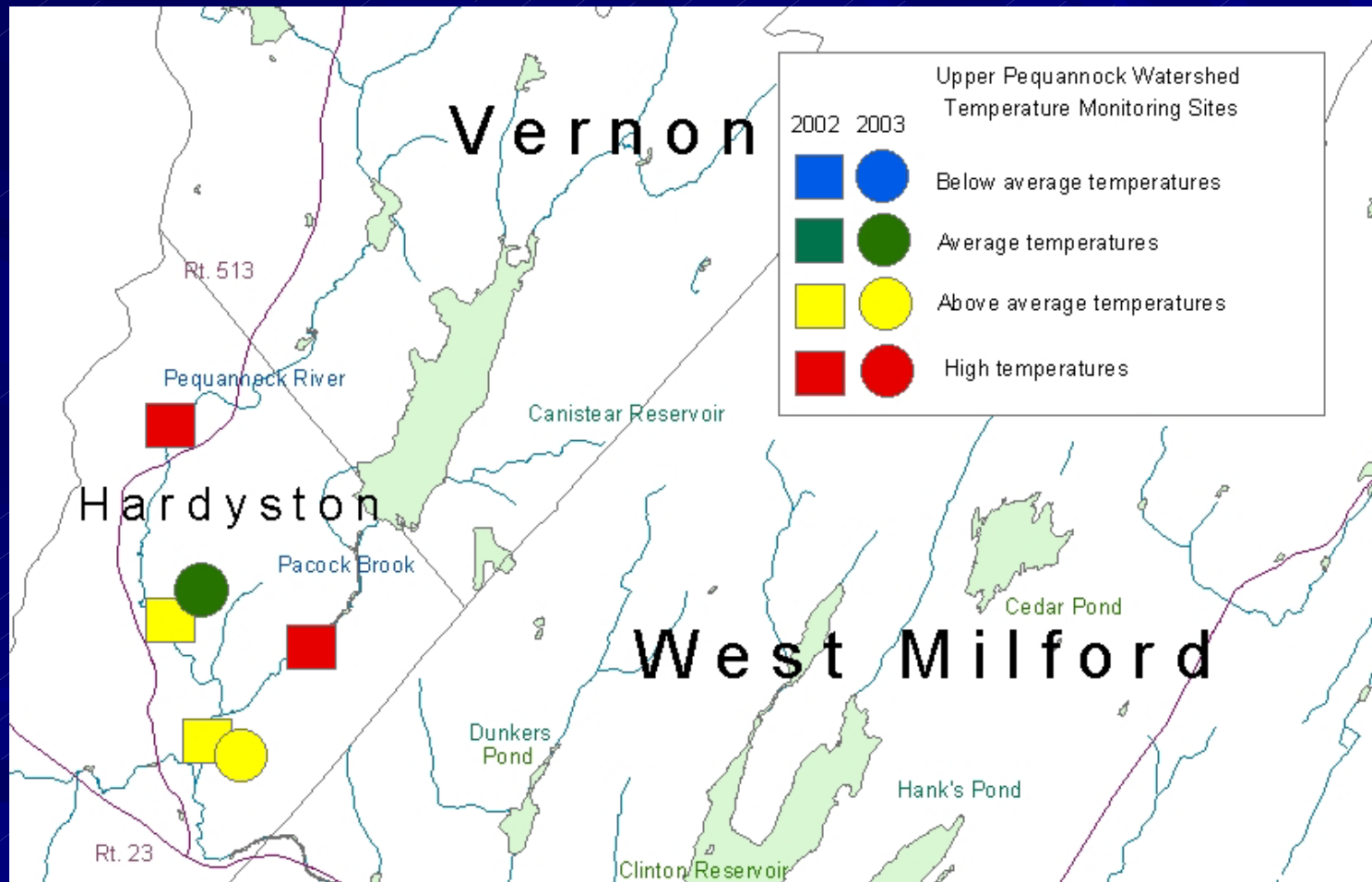
- Electronic “data loggers” are placed in rivers and streams in early summer.
- Loggers record temperatures at half-hour intervals.
- In early autumn loggers are collected and downloaded.



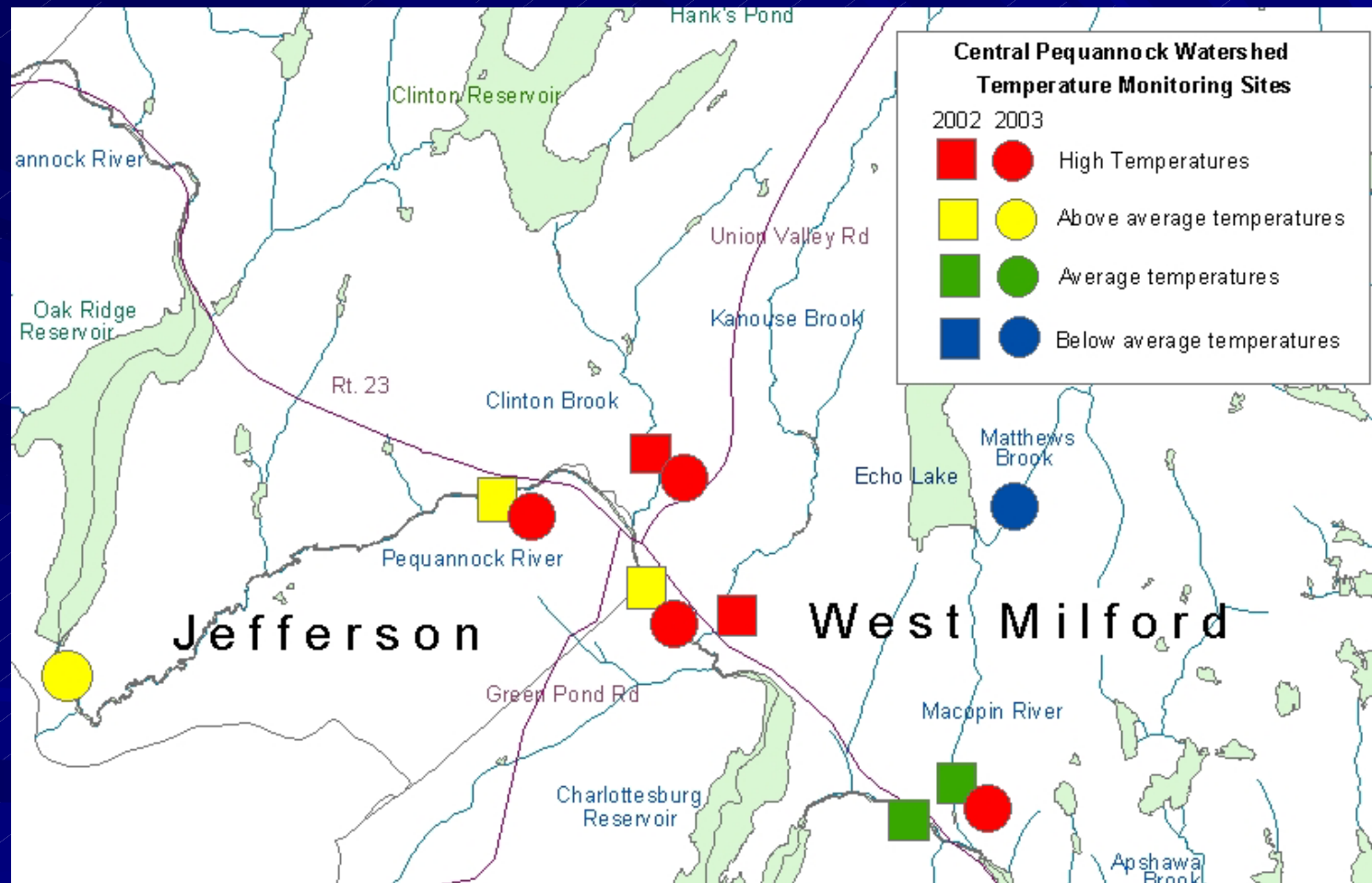
Temperature Monitoring Sites



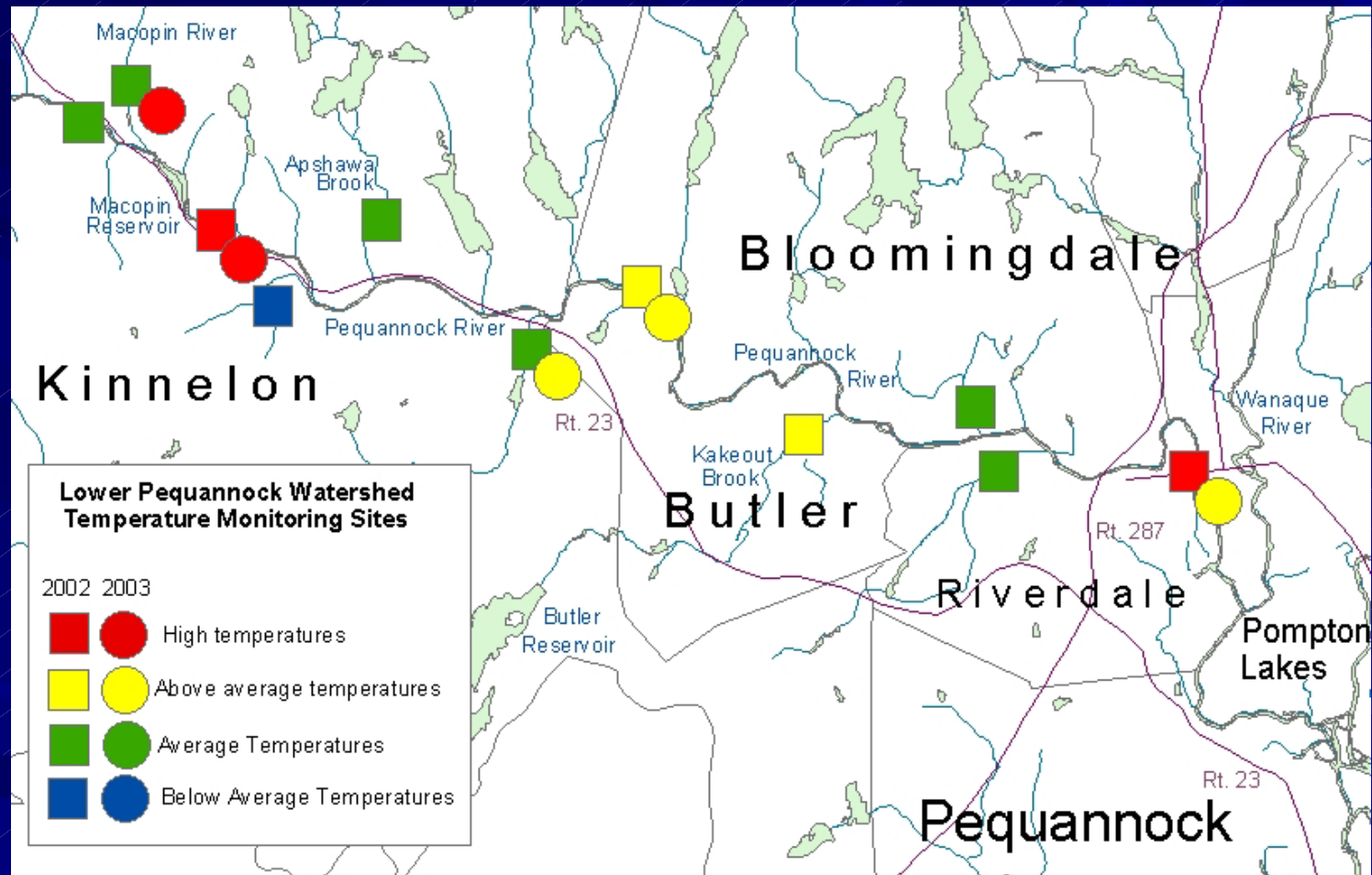
Temperature Monitoring Sites Upper Pequannock Watershed



Temperature Monitoring Sites Central Pequannock Watershed



Temperature Monitoring Sites Lower Pequannock Watershed



*Lessons
Learned:*

*Why is the
Pequannock too
hot?*



Reservoir Discharges:

Low release rates from reservoirs during hot weather can cause very high temperatures.

First reported fish kill was caused by low flows in
West Milford, July 1994
River Temperature 82F



Dams and impoundments

Dams with spillway outlets raise downstream temperatures. Even small impoundments can elevate temperatures substantially.

- Currents are slowed and exposed to direct sunlight.
- Spillway outlet skims the warmest upper surface water.



Matthews Brook, West Milford

Impervious Cover / Stormwater

Rainwater is heated by contact with hot roads, rooftops and parking lots. Heated runoff flows to rivers and streams.



Water lost as runoff fails to recharge groundwater, reducing river and stream flows later on.

Example:

We “know” that development patterns affect
water quality.

Can we prove it?

Let's try!

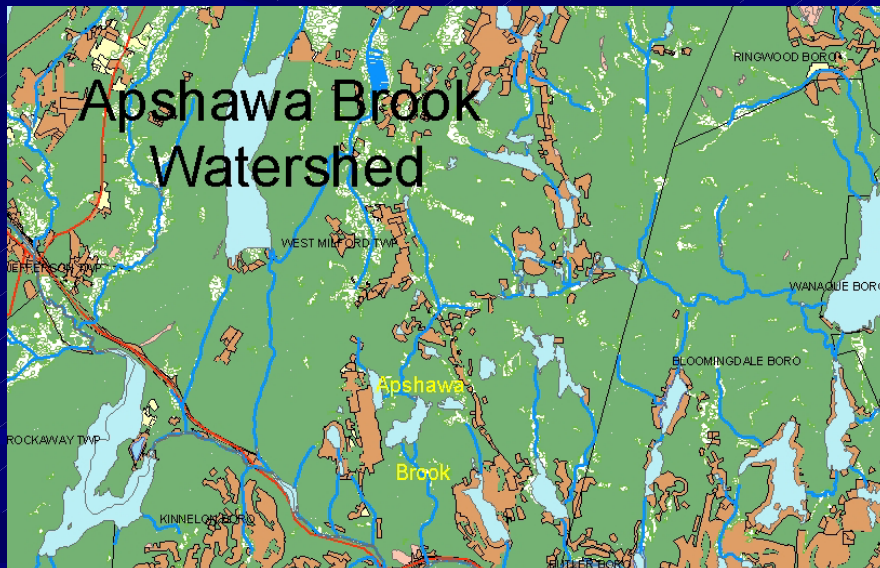


Example:

A Tale of Two Watersheds

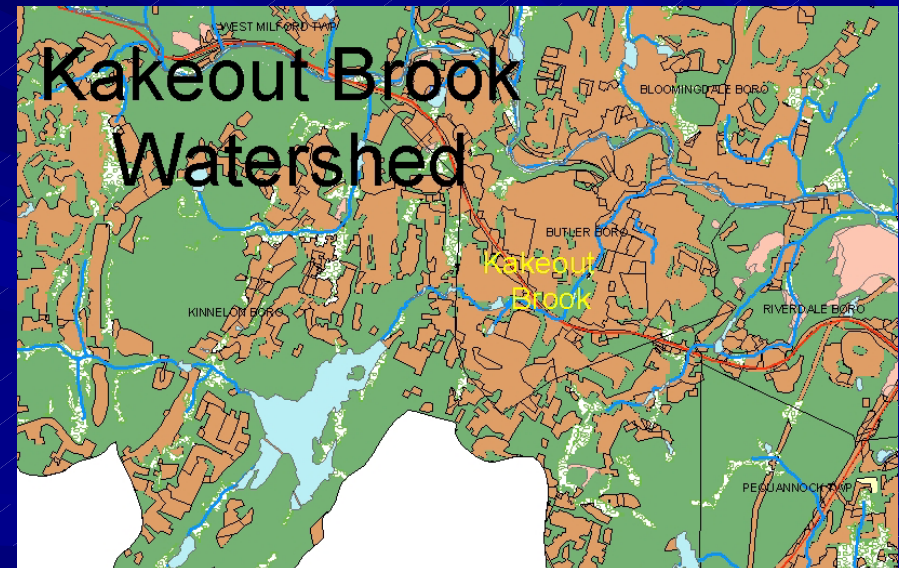
Sub-watershed 1

Low-density development
Less Impervious coverage



Sub-watershed 2

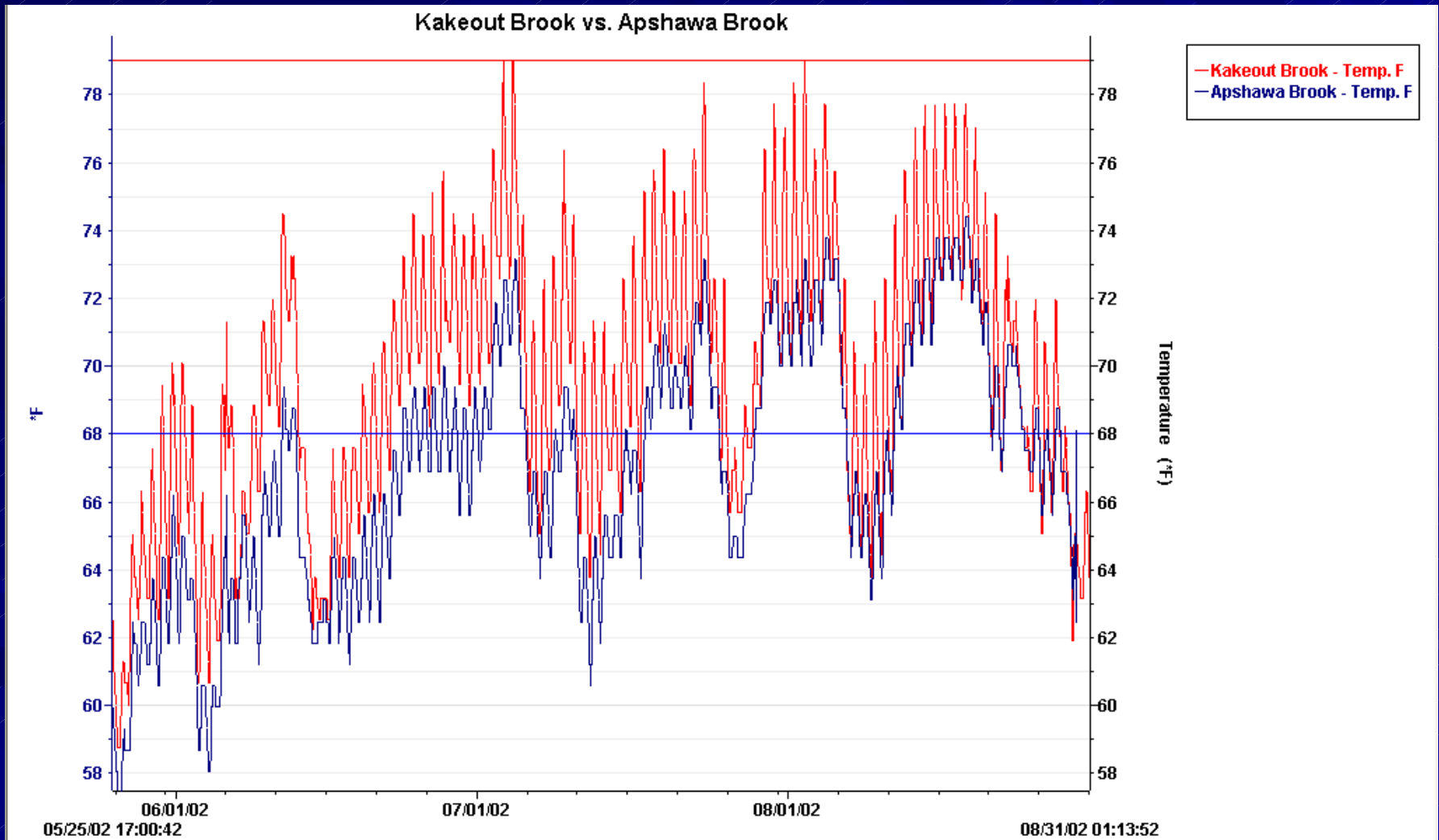
High-density development
More Impervious coverage



Which has cooler, cleaner flows?

And the winner is?

Temperature Comparison: Kakeout Brook vs. Apshawa Brook



Deforestation:

Shade trees are critical in reducing sunlight and lowering water temperatures



Pequannock River - Butler



Pequannock River below Macopin Reservoir - Kinnelon

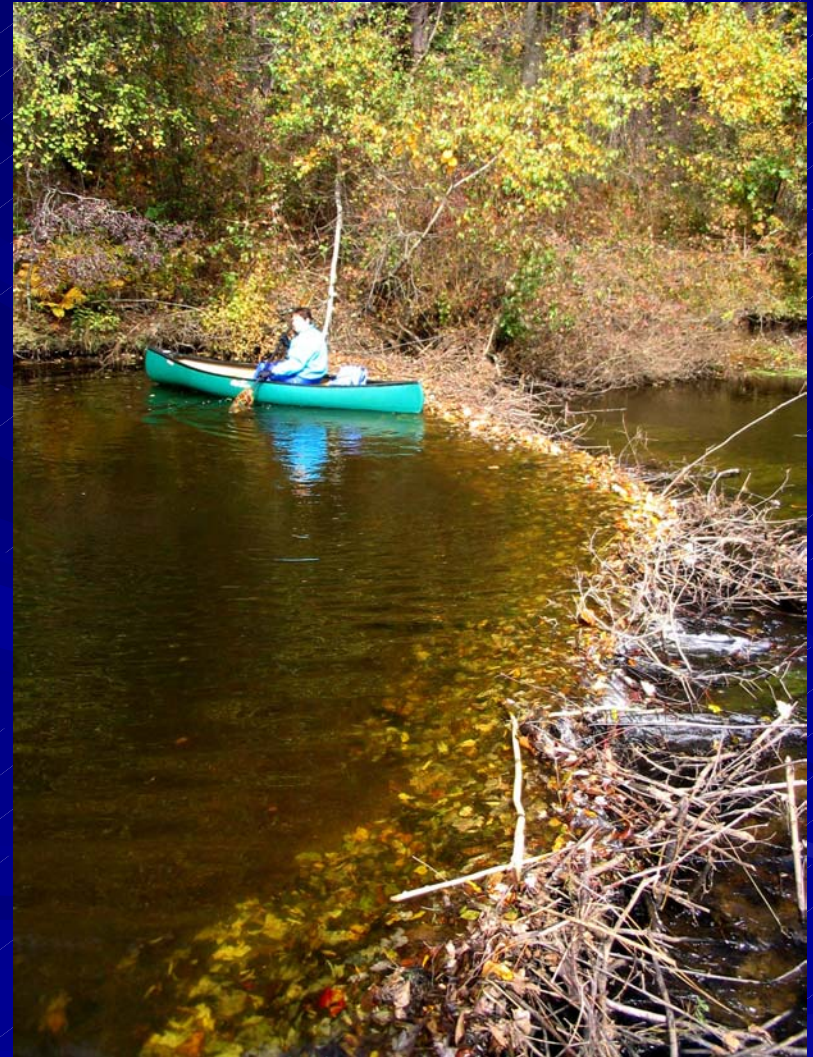
Beaver Activity

"Beavers do more to shape their landscape than any other mammal except for human beings..."

– Alice Outwater

"Busy fellows, beavers are..."

– Andy Panda



Beaver Activity

- Beaver ponds and dams act as small impoundments elevating river temperatures.
- Flooding of adjacent land kills trees, removing shading canopy
- Beaver harvest of trees also removes shading canopy



Where do we go from here?

Pequannock River Action Items:

- Continue monitoring to assess conditions and insure compliance with state standards.
- Increase flow rates from reservoirs.
- Explore ways to discharge cooler flows from impoundments.
- Remove beaver colonies where necessary.
- Replant stream/river banks.
- Protect critical lands – buffers, wetlands and groundwater recharge areas.
- Improve stormwater management techniques.

Was this monitoring worthwhile?

YES!!

Pequannock Watershed Achievements:

- Identification of high-grade tributaries/land tracts.
- “Impairment” listing of Pequannock River segments and tributaries.
- Expedited TMDL development.
- Modification of existing Water Allocation Diversion permit with temperature/flow requirements.
- Higher level of stormwater management.
- Better protection of stream/river buffers.

AND...

Increased recognition and sense of accomplishment for our contributors, members, staff and Board.



Broader Implications

In 2003 we monitored 26 sites - 12 locations in the Pequannock Watershed and 14 locations in the Wanaque Watershed.

22 of these sites, or 85%, were impaired for temperature.

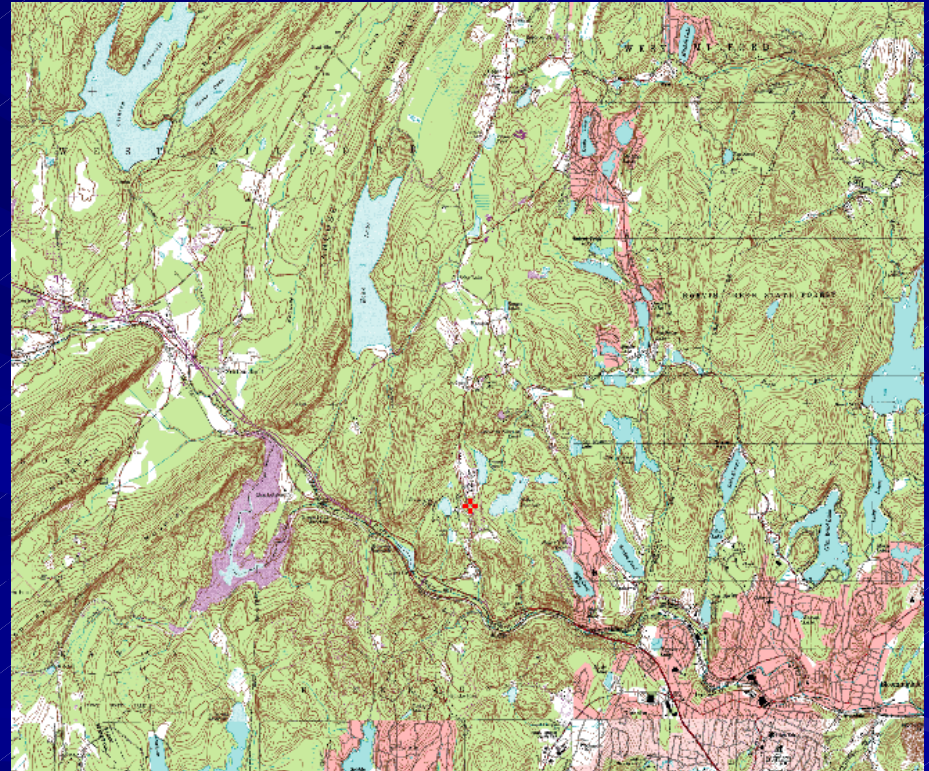
What does this mean for *your* watershed?

Getting Started in Temperature Monitoring: The Basics

Define the Project Scope

Consider the following:

- Major waterways
- Waterway classifications
- USGS or NJDEP stations
- Impoundments
- Tributaries
- Discharges (stormwater, NJPDES)
- Major shifts in development patterns



Develop QA/QC and Procedures

- Much depends on level or “tier” of your monitoring and whether you will pursue lab certification. More is better!
- Review existing successful plans. Beg, borrow, steal!
- Work with NJDEP to fine tune.

Standard Operating Procedures for
Pequannock River Coalition
Temperature Monitoring Program

PROTOCOL FOR PLACEMENT AND RETRIEVAL OF
TEMPERATURE DATA LOGGERS IN IDAHO STREAMS

Determine Funding and Labor Needs/Sources

- Develop an equipment budget.
- Develop a work plan – rule of thumb is minimum of 4 work days per monitoring site.
- Allot time to recruit and train staff or volunteers.
- Review funding sources – member contributions, 319H, private foundations, etc.



Purchase Equipment

- Data Loggers – one per site
- Software (from data logger vendor – ONSET!)
- Lab equipment – NIST certified thermometer
- Field equipment – mounting hardware for logger deployment, chest waders, GPS unit (optional).



The Monitoring Cycle

- May – check logger calibration
- May-June – deploy loggers
- July-August – field check of calibration
- September – collect/download loggers and recheck calibration
- October-December – organize and review data
- January-April – shovel snow, ski, sleep, go to Bahamas



Are You Certifiable? Probably!

Requirements:

- 1 - Dedicated laboratory “manager” with experience or training.
- 2 - High-grade, approved QA/QC Plan and Procedures.
- 3 – Quarterly calibration checks of data loggers.

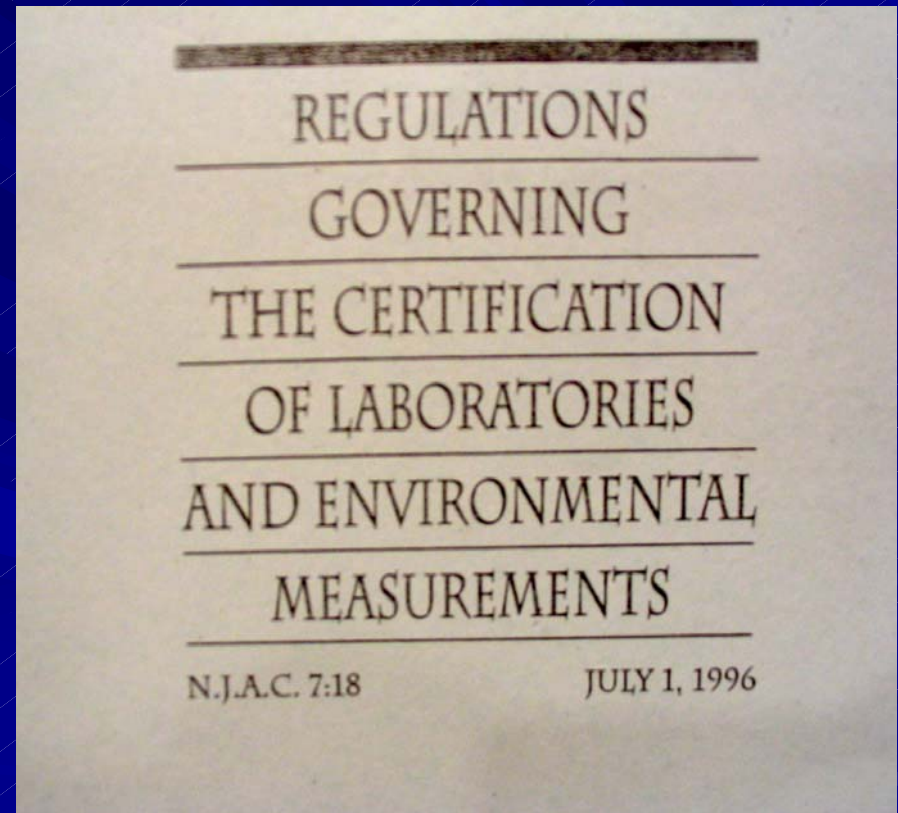


- 4 – Annual recalibration of NIST thermometer.
- 5 – Solid documentation of calibration tests, deployment sites, collected data, etc.
- 6 – Annual license fee (\$900).

Certification Requirements

Specific requirements are detailed in “Regulations Governing The Certification of Laboratories And Environmental Measurements”.

This publication is available from the NJDEP Office of Quality Assurance.



Consider a phased approach:

Year 1

- Assess your watershed
- Select a limited number of key monitoring sites
- Familiarize staff/volunteers with equipment and procedures
- Establish funding sources
- Develop QA/QC and procedures
- Deploy loggers, produce baseline data

Phased Approach: Year 2

- Based on prior year results, refine/add monitoring sites to home in on specific problem sources.
- Adjust QA/QC and procedures as necessary.
- Acquire additional equipment, if needed.

Phased Approach: Year 3

- Continue refinement of monitoring sites, QA/QC and procedures.
- Pursue certification (if desired) facilitated by experienced/trained staff/volunteers, sufficient equipment and established QA/QC and procedures.
- Submit data to NJDEP – remember that prior data may be accepted.

Remember:

*“Boundaries don't protect
rivers, people do.”
- Brad Arrowsmith*

Thanks!

***Any
questions?***



Information Sources:

- ONSET Computer Corporation (data loggers and software) P.O. Box 3450, Pocasset, MA; (800)564-4377; www.onsetcomp.com
- Pequannock River Coalition; P.O. Box 392, Newfoundland, NJ 07435; (973)492-3212; www.pequannockriver.org
- NJDEP Office of Quality Assurance; P.O. Box 424, Trenton, NJ 08625-0424; (609)292-3950

Public Outreach and Education

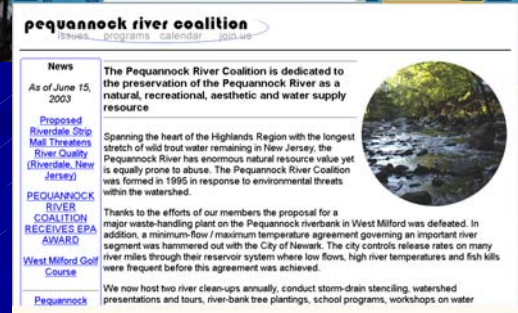
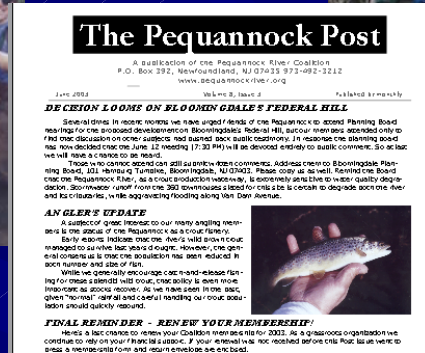
■ Hikes and tours

■ Presentations

■ Publications

■ River cleanups and restorations

■ Website



Advocacy, Regulation and Public Policy

- Local land use issues
- River “Watchdogs”
- State policy and regulation
- Stormwater management

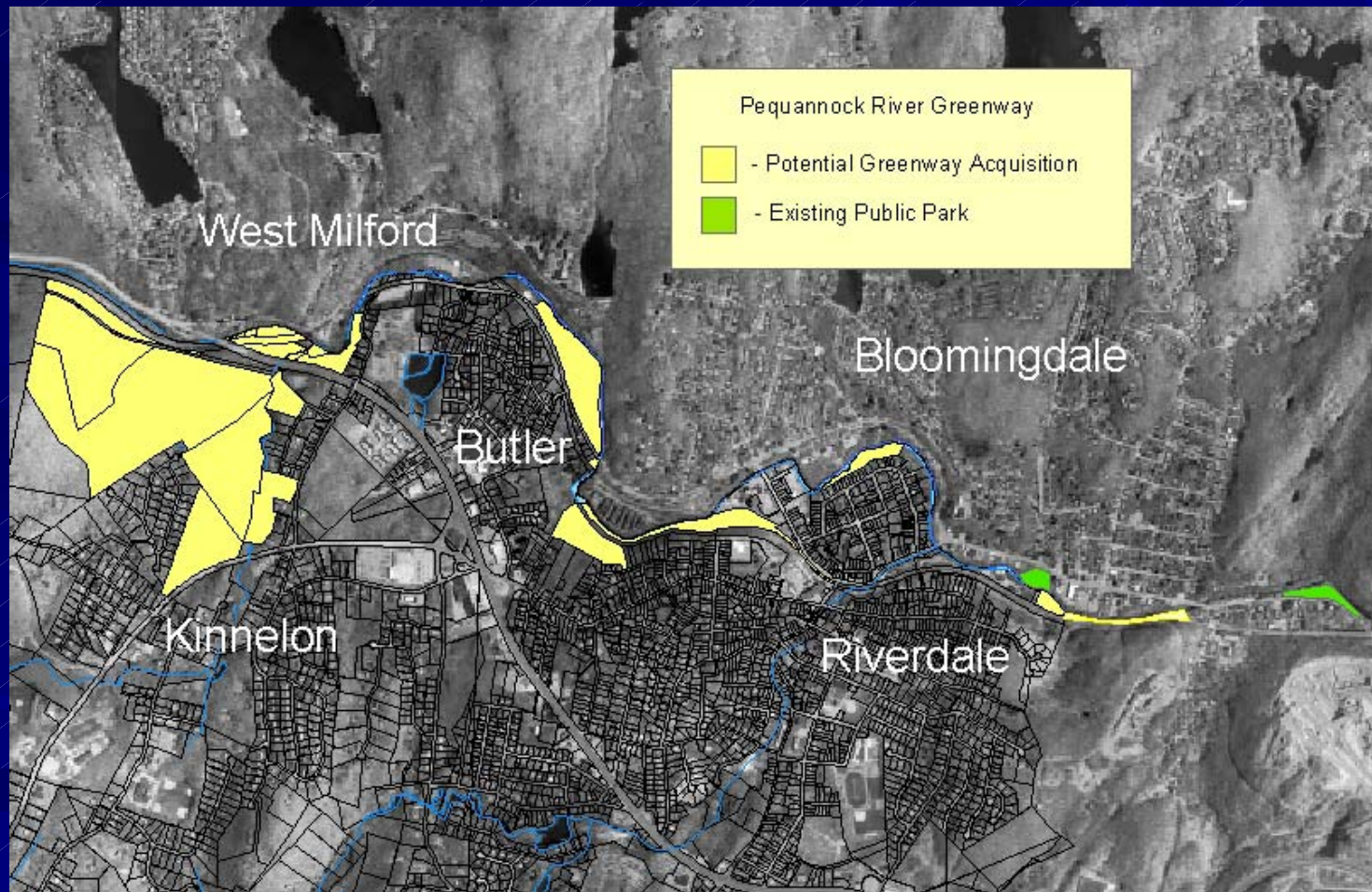


River Access - Greenway

- Identification of key land parcels
- Work toward acquisition
- Incorporate Greenway concepts into local development projects
- Increase funding for Open Space



Lower Pequannock River Greenway

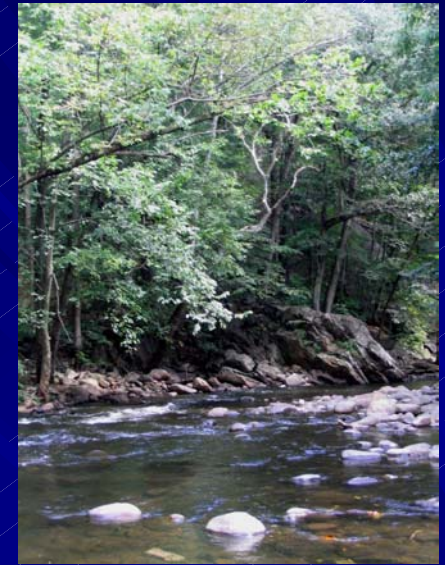




Weber Tract - Kinnelon



Redevelopment Zone - Butler



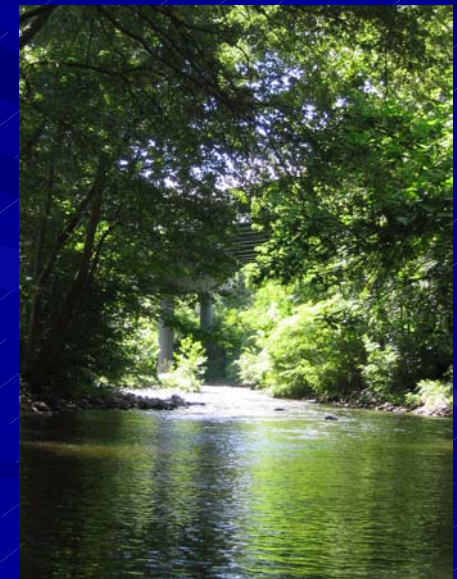
Federal Hill -Bloomington



Mill Raceway - Butler



Macopin Road - Bloomington



Rt. 287 - Riverdale

Greenway Properties